

Computer Science 3331A: Foundations of Computer Science I 2018–19 Course Outline

Course Description

We live during the computer revolution, which is changing fast everything around us. While programming languages change fast, the basic underlying theory does not. This course covers the basic concepts of the theory of computation. To study computation thoroughly, we need models. Ideally, we would like simple models to solve our problems. This is what the theory of computation is about: computational models and their power, with an impressive array of applications. That includes finite state machines, regular expressions, push-down automata, and context-free grammars. A crucial aspect is studying the limits of computations, which involves investigating all powerful models, such as Turing machines. Some problems are intractable, that is, it takes ages to solve them, others are provably impossible to solve even on an infinitely powerful computer. Computability theory sheds light on these issues of fundamental importance to anyone attempting to understand what computers can do for us.

Lecture and Instructor Information

Section	Time	Room	Instructor	Office	Office Hour	Email
001	Tu: 3:30–5:30 pm W: 9:30–10:30 am	NCB 113	Dr. Robert Moir	MC 385	W: 10:30–11:30 am	rmoir3@uwo.ca

If you are contacting your instructor, please use your Western email address.

Prerequisite Requirements

Computer Science 2214: Discrete Structures for Computing or Mathematics 2155: Discrete Structures I or registration in the third or fourth year of an honors program that combines Computer Science and another mathematical science or SE 2251A/B (251A/B) and registration in the third year of the BSc program in Software Engineering. Beware of the following Dean's rule:

Unless you have either the prerequisites for this course or written special permission from your Dean to enrol in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Course Materials

- Required Text: Elaine Rich, Automata, Computability, and Complexity. Theory and Applications, © Person Prentice Hall (2008), ISBN 978-0-13-228806-4. ([errata](#))
- Other materials will be provided in the Resources folder of the OWL site for the course.

Tools

- [JFLAP](#) software for experimenting with formal languages, including FSM, PDA and TM.
- NB: JFLAP can be used on assignments, but it cannot be used on exams.

Lecture Topics

- Regular Languages
 - Finite State Machines (FSM)
 - Deterministic (DFSM)
 - Nondeterministic (NDFSM)
 - Regular Expressions (RE)
 - Regular Grammars (RG)
 - Minimizing DFSM
 - Conversions between DFSM, NDFSM, RE and RG
 - Proving regularity
 - Closure properties
 - Proving nonregularity
 - Pumping theorem
 - Using closure properties
 - Decision Problems
 - Membership, Emptiness, Totality, Finiteness, Equivalence, Minimality
- Context-Free Languages
 - Pushdown Automata (PDA)
 - Context-Free Grammars (CFG)
 - Conversions
 - PDA \leftrightarrow CFG
 - CFG \rightarrow Chomsky Normal Form
 - Ambiguity
 - Proving context-freeness
 - Closure properties
 - Proving noncontext-freeness
 - Pumping theorem
 - Using closure properties
 - Decision Problems
 - Membership, Emptiness, Finiteness
- Undecidability
 - Turing Machines (TM)
 - Deterministic TM
 - Decidable languages (D)
 - Semidecidable languages (SD)
 - Multi tape TM

- Nondeterministic TM
- Universal TM
- Halting Problem
- D and SD
- Enumeration
- Reduction
 - Using reduction to prove undecidability
- Rice's Theorem
- Non-SD languages
- Unrestricted Grammars
- Non-TM Problems
 - Post Correspondence Problem (PCP)
 - Context-free language problems

Evaluation (tentative due dates)

The overall course grade, out of 100, will be calculated as listed below.

Component	Notes	Value
5 Min Quizzes	Worth 1.25% each (in Tuesday class, announced previous Friday)	5%
Assignments	Worth 10% each	40%
Midterm Exam	Tuesday October 30 (in class)	25%
Final Exam	Scheduled by the Registrar	30%

No electronic devices may be in your possession during tests and exams.

Notes:

- The four quizzes (5-10 minute duration) are single questions that test conceptual understanding, and will be scattered throughout the term.
- Assignment 1 (10%) is (tentatively) due **Tuesday October 16**.
- Assignment 2 (10%) is (tentatively) due **Tuesday October 23**.
- Assignment 3 (10%) is (tentatively) due **Wednesday November 28**.
- Assignment 4 (10%) is (tentatively) due **Wednesday December 5**.
- Midterm Exam (25%) covering Regular and Context-free Languages is **Tuesday, October 30 in class** (110 minute exam) and is worth 25%.
- Final Exam (30%) covering Turing Machines and Undecidability is TBA (3 hours).

It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so, and the student must accept the mark obtained. Claims of medical, physical, or emotional distress after the fact will not be considered.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website:

www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Teaching Assistants

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|---|------------------|
| • Nick Delben (ndelben@uwo.ca) | Office Hour: TBA |
| • Caocao Liu (ciliu567@uwo.ca) | Office Hour: TBA |
| • Da Zhi (dzhi@uwo.ca) | Office Hour: TBA |

Assignments

The assignments will consist of a set of exercises related to the material covered in class. The solutions for the exercises should be neatly written or typed.

All assignments will be made available on the course web site. The availability of assignments will be announced on class and/or via email. Students are responsible for checking their email on a regular basis.

Appeal of Assignment Marks

Appeals of assignment marks should be addressed to your TA first. If you and the TA cannot agree, then the TA and the student will discuss the situation with the instructor. That decision will be final.

Appeals must occur within 1 week from the first day that the marked assignments or midterm exam were made available to students. After that 1 week period has gone by, no further appeals will be considered and the marks are considered final. Note that this rule applies even if assignments are not picked up when passed back. The week (8 day) count down starts from the date the assignment is passed back.

Late Assignment Policy

There is no penalty for late submissions up to three days. After that the late work is no longer accepted.

If you have serious medical or compassionate grounds for an extension, you should take supporting documentation to the Academic Counseling office of your faculty, who will contact the instructor. Workload, exams, minor illnesses, and home computer problems are not valid reasons for being unable to complete an assignment within the allotted time (unless your academic councilor thinks otherwise).

Computing Facilities

Each student will be given an account on the Computer Science Department senior undergraduate computing facility, GAUL. In accepting the GAUL account, a student agrees to abide by the department's Rules of Ethical Conduct.

Accessibility

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

For more details see the policy on Accommodation for Students with Disabilities
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf.

Email Policy

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html>, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Tutoring

The role of tutoring is to help students understand course material. Tutors should not write part or all of an assignment. Having employed the same tutor as another student is not a legitimate defense against an accusation of collusion, should two or more students hand in assignments considered similar beyond the possibility of coincidence.

Ethical Conduct

Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offense, at the following Web site:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offense. All assignments are individual assignments. You may discuss approaches to problems among yourselves; however, the actual details of the work (assignment coding, answers to concept questions, etc.) must be an individual effort. Assignments that are judged to be the result of academic dishonesty will, for the student's first offense, be given a mark of zero with an additional penalty equal to the weight of the assignment also being applied. You are responsible for reading and respecting the Department of Computer Science policy on Scholastic Offenses and Rules of Ethical Conduct. The University of Western Ontario may use software for plagiarism checking. Students may be required to submit their written work and programs in electronic form for plagiarism checking.

Missed Course Components

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible.

If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in WSC 140, and can be contacted at 519-661-3040 or scibmsac@uwo.ca. Their website is: https://www.uwo.ca/univsec/pdf/academic_policies/general/academic_counselling.pdf.

A student requiring academic accommodation due to illness must use the Student Medical Certificate (http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf) when visiting an off-campus medical facility.

For further information, please consult the university's medical illness policy at www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf.

If you miss the Midterm Exam there will be no makeup. Instead, your Final Exam grade will count for 55% of your final grade.

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Mental Health

Students who are in emotional/mental distress should refer to the Mental Wellbeing website: https://www.uwo.ca/health/mental_wellbeing/index.html and Health website: <https://www.uwo.ca/health/> for a complete list of options about how to obtain help.

Academic Accommodation for Medical Illness

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your Academic Counseling office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed.

For further information please see: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf.

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Support Services

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to the Mental Wellbeing website: https://www.uwo.ca/health/mental_wellbeing/index.html and Health website: <https://www.uwo.ca/health/> for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC, <http://westernusc.ca/services>.

The website for Registrarial Services is <http://www.registrar.uwo.ca>.